

TITLE

DRAINAGE SUPPORT MATRIX

CROSS-REFERENCES TO RELATED APPLICATIONS

5 This is a Continuation-in-Part of U.S. patent application serial number 10 / 775,459,
filed on February 10, 2004, by the same inventor, for MULTI-USE FLUID
COLLECTION AND TRANSPORT APPARATUS, and for which priority under 35
USC 119(e) and 120 is hereby claimed.

10 STATEMENT REGARDING FEDERALLY SPONSORED RESEARCH OR DEVELOPMENT

Not Applicable

BACKGROUND OF THE INVENTION

15 1. Field of the Invention

 This invention relates generally to devices and constructs used to enhance
subterranean drainage from building structures and entrenchments, such as walls,
footings, foundations, as well as drainage from under garage and basement floors, where
overburden of concrete exacerbates the collection of water. Specifically, this invention
20 embodies a drain assembly improvement using a simplified support matrix that may be
used with membranous covers, stone or other adjuncts. The matrix can sustain great
overburden and is inherently pliable enough to be rolled and used as a flexible drain

assembly (or "blanket-drain") over and around structures that would otherwise have to be served by more cumbersome and costly drainage systems.

2. Discussion of Relevant Art

It has long been a practice, in the construction industry, to provide some form of drainage to subterranean structures. Ground water seepage remains a problem in most non-arid regions of the world; and, building footings, garage floors (multi-level) and walls, facing surface and subsurface waters, have been most susceptible to water incursions. Many drainage devices have been provided, as well as adjuncts thereto, in order to provide adequate carry-off or transport of these undesired waters. Other patents, secured by the instant inventor, adequately cover the use of membranous coverings, such as filter fabric and impermeable sheeting. This paper will deal primarily with supporting structures for use with such coverings and expand on the basic concepts disclosed in the earlier, priority document.

Five disclosures are germane to this discussion, relative to the extant art: U.S. Patents Nos.: 3,965,686 ('686), issued June 29, 1976, entitled DRAIN SHEET MATERIAL; 4,995,759 ('759), issued February 26, 1991, entitled DRAINAGE TUBE CONSTRUCTION; 6,527,474 ('474), issued march 4, 2003, entitled PAVEMENT DRAIN; 4,019,326 ('326), issued April 26, 1977, entitled NONWOVEN HORIZONTAL DRAINAGE SYSTEM; and, 5,152,892 ('892), issued October 6, 1992, entitled SPIRAL FILTER ELEMENT. All of these patents show, to some degree, the functionality of the coiled or spiral element in providing a conduit for fluids and having a relatively low or limited deformation character. However, it is in the careful study of each disclosure that one

perceives, albeit suitability for intended purpose, its limitations when compared to the ready adaptability of the instant invention.

Issued to Saito et al., '686 details a compound sheet apparatus wherein a plurality of coils or internally strengthened tubules are parallel-arrayed, embedded in a non-woven fibrous material and disposed between two thin sheets of filter fabric. The apparatus' outer sheets are both porous and not suitable for placement against vertical walls. Most limiting is the necessity for the fibrous "filling" in which the tubules are embedded. When used for the specific purpose shown in '686, and notwithstanding the "filling", the apparatus appears to enjoy some flexibility; however, it seems intuitive that doubling the thickness of the "sandwich" would render such flexibility problematical. A characteristic of its construction, the use and dependence upon flow direction-constraining fibers, obviates a bi-directional emplacement of the apparatus on surfaces that may change in pitch direction or present a configuration that will not allow the use of a constrained-flow device.

A single-purpose drainage tube, for use in entrenchments, is shown in '759. The apparatus consists of a length of drain formed by a fixed tangential connection of parallel, equal-length sections of tubing, on a longitudinal axis that is perpendicular to the axes of the sections. The tubing consists of corrugated pipe; and, the assembly is completed by enveloping the above apparatus in a filter fabric. Although more stylized emplacements can be conceived for the apparatus, it appears that in the vertical drainage mode, turning of corners is impossible because the longitudinal fixation denies flexibility, as defined and required by the instant inventor.

Although not intended to flex, the pavement drain member of '474 is remarkable in that it is essentially a plain *resin* coil, albeit composed of two arcuate strands in fixed adjacency. The coil possesses a minimal gap between each annular section so as to obviate infusion of macadam, when it is set onto the asphalt medium. Water will infuse
5 readily into the coils and be transported from the tarmac base. The primary motivation for the use of a stylized resin coil is to provide a structure having high overburden sustainability, a tunnel-like effect for transporting fluids and a possession of pseudo-homogeneity with the tarmac. The latter characteristic obviates coil interference during destruction (by grinding) of the tarmac.

10 The subsurface soil drainage system of '326 employs a porous mat, of non-woven fibers, in which is centrally embedded a tunnel-shaped agglomeration of heat-spun filaments of spiral or coil geometries. Subsurface waters, infusing the mat, are carried off through the tunnel of filaments, thus draining the surrounding soil. This apparatus requires a considerable thickness (and amount) of non-woven mat, making it unsuitable
15 for the purposes of draining most structures. It also appears to lack the degree of flexibility required by the instant inventor.

Final to this review of relevant art is patent '892, for a spiral filter element possessing a special expansion-compression character. It is essentially a filter-covered *spring*, the coils of which are formed so that the gaps between the (analogical) annuli gradually
20 increase in size from one coil end to the other. This predisposition of the element assures that, when vertically and operatively oriented, each discrete section of the coil is capable of sustaining the mass of the coil sections above it. Placed in a horizontal position, the

spring gap variations of this element would defeat its purpose in any planar filtration ensemble.

Although for the most part, structure and soil draining, with concomitant filtration, is still performed using tiles, large amounts of stone and paper/fabric overlay (such as in
5 drywell and septic usages), it is the instant inventor's contention that conscientious builders should transition to more efficient, effective and reliable draining and filtering modalities.

The instant invention provides an easily manipulated, flexible device that can be emplaced both adjacent to and beneath concrete structures and earthen constructs, as well
10 wrapped about articles such as pipes, cylinders, corners and generally planar surfaces.

INCORPORATION BY REFERENCE

Because they show both the present state of the art in drainage devices having an internally channeled structure, as well as disclosing filtering adjuncts or various stand-off
15 mechanisms, U.S. patents, numbers 3,965,686, 4,995,759, and 6,527,474, with the aforesaid priority application, are hereby incorporated by reference.

DEFINITIONS

Generally throughout this disclosure, words of description and claim shall have
20 meanings given by standard English usage; however, certain words--preponderantly nouns--will be used that may have a more stylistic (in **bold-face**) meaning and are defined as follows:

arrangement - herein, the placement of basic support **elements** of the invention that will compose a duct-like **member**;

array - the order of two or more **members**, not necessarily planar;

blanket-drain - a term of art used herein to refer to the assembly / ensemble for, or
5 method of, providing below grade / structure drainage using the inventor's preferred and alternate planar **array** embodiments;

construct - generally, an article or a building structure;

continual - having intermittent, or periodic, breaks or discontinuities;

continuous - having no breaks or discontinuities;

10 **continuum** - suggesting a continuity of some feature, such as a covering;

cross-link - the attribute of joining / communicating between support **elements** or **members** of the invention;

coupling - herein, a physical fixed, rigid or movable linking of **elements** or **members** of the invention;

15 **duct** - a unit used for fluid transport, having generally an axially void, elongated, **skeletal** appearance, and typifying the **member** of the invention;

element - the basic constituent of the invention having a particular **geometry** (shape) that has ordinarily a central void, the void optional in arcuate or curved **elements**, and wherein the **element** itself comprises one or more of the **geometries**;

20 **gang(ing)** - a group(ing) of **elements**, of any shape, into one or more configurations in order to arrange the resultant **members** into other than purely planar **arrays**;

hoop - an element having (particularly) a generally circular **geometry**, also **ring** and **annulus(lar)** and, concatenated in a coil **member**;

integral - necessary to complete or in itself complete;

longeron - a longitudinal element that connects parts of a series, such as the centrally void, geometrical (**elemental**) parts of the invention;

member - a part of the invention consisting of an arrangement of its constituent
5 **elements**, generally in-line;

membrane or **membranous** - of or pertaining to a porous/non-porous, thin sheet of material, irrespective of its composition, as opposed to **mat** or **matted**;

nodule - a projection of indefinite shape that can be, simply, a **detent** or **dimple**;

permeable - the quality of allowing a fluid, to pass through;

10 **polyform** - any form, assembly or construct using **support elements** or **members** of the invention;

quasi-tubular - the character of a support **member** that emulates a **duct**, but only to the extent that it is **skeletal**, elongated and sustains an axial void;

rigid - a physical property of an object wherein the object substantially resists
15 deflection in a particular dimension (direction) or plane;

sandwich - the configuration made by placing one planar surface over, but set apart from a second surface, and wherein either may be *virtual* or referenced as **face(s)**;

skeleton(tal) - the arrangement of **elements** of the invention manifesting a multi-aperture character;

20 **stagger(ed)** - the arrangement of **members** in a parallel posturing so that the **elements** of each may interleave with the other/others;

Standoff - a spacing **support element** or device that facilitates the setting apart of articles, e.g., membranes or stone;

stringer - generally, but not necessarily, an elongated structure that effects connection between the **members** (*Cf. longeron*);

support - generally used as an adjective with **elements** and **members** of the invention;

5 **tubule** - item (**member**) of the invention having a **duct-like, skeletal** appearance;

unitary - having wholeness, as in a single unit or monolith composed of plural members.

The above listing is not exhaustive. Certain other stylized terms, used previously or hereafter, are defined at the time of their first usage or placed in quotation marks and
10 used with conventional wording.

BRIEF SUMMARY OF THE INVENTION

The deficiencies and limitations of the earlier art, namely complexity, cost and, in most instances, inflexibility are overcome by providing an inexpensive, easily applied
15 innovation that facilitates collection and removal (transport) of subsurface or sub-structural waters. Additionally, a continued rollup or wrap-around capability of the instant drainage assembly enhances it greatly in respect of packaging and shipping, as well as use in the field.

Critical to the synthesis of the invention is the use of discrete elements, of a generally
20 circular (hoop) or common geometric definition. These elements are concatenated, to form a coil, or are placed in a coaxial arrangement along a membrane (fixed thereto) or integral with, and along, at least one longeron. Both of these constructs give the resultant (member) a duct-/tunnel-like or quasi-tubular/conduit shape and, when arrayed by

parallel alignment or cross-linking, emulate a planar/blanket article that possesses excellent flexibility, provides exceptional overburden support and facilitates fluid transport, after its passage through the spacings in, about and between the elements.

Defined, in only the general sense, as planar/sandwich morphology, the invention
5 consists of an array of the strong, firm, non-biodegradable members that are, in a pristine sense, configured as supportive, stand-off elements that *optionally* bear a porous (or impermeable) membranous covering of geo-textile filter fabric (or sheet plastic) on at least one face of the array. Depending on the use of this relatively flexible assembly, the other face of the array may bear the same type of membranous covering or no covering at
10 all, save for an optional mesh. The latter (mesh) is employed, at a manufacturer's discretion, to enhance the structural integrity of the assembly and is apparent in but one modality of the invention as a crosshatch, or network, of longerons and/or stringers.

Members may also be fixed to the covering(s) by any adhesive suitable for a permanent, water-impervious and non-biodegradable existence; many are available
15 throughout the automotive, construction and plastics industries.

With the invention, there is acquired not only a device that has unlimited in-ground use, with high overburden sustainability, but one retaining a high degree of flexibility that allows wrapping about an article / structure or compact rolling-up, for ease in handling, storage and shipment.

20

BRIEF DESCRIPTION OF THE SEVERAL VIEWS OF THE DRAWINGS

Of the Drawings [*Caveat*- the following illustrations are for explanation only and no sizes nor dimensions should be inferred unless explicitly stated]:

FIG. 1 is a representation of the preferred embodiment for a standoff or support member of the invention;

FIG. 2 a representation of an alternate to the preferred embodiment of the standoff or support member of the invention;

5 FIG. 3 is a drawing of the FIG. 2 member having a structural reinforcement, termed a longeron;

FIG. 4 is a plan view of the FIG. 1 member, in-place and adjacent a compounded version ("doublet") thereof;

FIG. 5 is an end elevation of the FIG. 4 assembly;

10 FIG. 6 is a plan view of the FIG. 2 member, in-place and adjacent a doublet version of the FIG. 3 member;

FIG. 7 is a plan view of an optional arrangement of one or both elemental embodiments of FIGS.1 - 3;

FIG. 8 is an illustration of the confection technique for a small section of the invention
15 sandwich assembly;

FIG. 9 is a drawing of a model of the invention, diminutive only in its surface area;

FIG. 10 is a sectionalized end elevation of the FIG. 9 model;

FIG. 11 is a sectionalized end elevation of the FIG. 9 model, bearing an optional partial covering;

20 FIG. 12 is an end view depicting the ability of the FIG. 9 device to negotiate an around-the-corner emplacement;

FIG. 13 shows an alternate construction of the preferred embodiment requiring no coupling membrane;

FIGS. 14A and 14B depict, respectively, the support elements preparatory to their engagement with a longeron of an adjacent member and a detail of the discrete element; while, FIG. 14C presents an end elevation of the FIG. 13 construct;

FIG. 15 shows the construct of FIG. 8 employing stringer(s), in lieu of coupling
5 membrane(s);

FIG. 16 depicts a modification, a further compounding, of the FIG. 4 “doublet”, and FIG.17 an end elevation thereof;

FIGS. 18 and 19 are correlative illustrations, respectively, of the FIGS. 16 and 17 modification in the staggered arrangement of compounded members;

10 FIG. 20 illustrates an arbitrary poly-formation of invention;

FIGS. 21 and 22 depict end elevations of suggested support elements (geometric shapes) of the invention, with optional bracing features;

FIG. 23 presents an end elevation of stacked members of the invention; and,

FIGS. 24 and 25 show, respectively, a plan view and end elevation of the FIG. 2
15 member in a compound construct.

DETAILED DESCRIPTION OF THE INVENTION

Before commencing this description, the reader is referred to the DEFINITIONS, given above. The materials of construction are well known in the industry and no further
20 mention will be made of them other than that the filter fabric is in common usage, in sheet (“membrane”) and mat forms, and the support or stand-off members may be composed of any strong, non-biodegradable resin or polymeric, such as polyamide, polyester or polyvinyl chloride. In short, the physical characteristics of the materials

comprising the standoff members should be heat-melt formable to facilitate manufacture by extrusion, casting or injection molding processes. The heat melt character also facilitates fusing of the various elements.

Referring now to **FIG. 1**, there is depicted, in the preferred embodiment, a support /
5 standoff member **10** of the invention. It is, substantially, a duct-like or quasi-tubular item comprised of a series of hoop or ring elements **12** that are axially aligned on and integral with a longeron **14**. The member is generally produced by injection molding as a unitary item. The particular annular shape is chosen because of its resistance to deformation likely to be caused by centripetal forces, such as overburden of soil or concrete.

10 The alternate support / standoff member is shown in **FIG. 2**, and is described simply as a coil **20**. As is readily apparent, a series of hoops / annuli **22** are, by the nature of a coil, axially aligned, but not discretely closed. Although being made of similar material, the coil lacks the inherent strength of the preferred embodiment support member **10** because there is no structure to confine any one annulus to its median plane **23**. To
15 compensate for a hoop's tendency to contract or expand out of it's median plane, the **FIG. 3** modification is made. Therein, a longeron **24'**, peculiar to the coil **20**, is added. Whereas the coil is readily made by extrusion techniques, the element of **FIG. 3** requires secondary processes that require its alternate embodiment nomenclature, in the instant invention. As was discussed in the above discussion of relevant art, a coil without an
20 intermediate support, such as the filler medium of U.S. Patent No.: 3,965,686, will simply be unable to sustain the great overburdens anticipated in most subsurface emplacements. It is, however, desirable and used where feasible, because of its inherent flexibility--

generally as a cross-linking (entwinement) element or when adequately constrained (see **FIGS. 7 and 24**).

FIG. 4 introduces an optional use of the support member **10D**, also referred to as a “doublet”. The doublet is a cohesion of two member units **10** generally, *but not*
5 *necessarily*, along their respective longerons **14**. Here, in plan view, the doublet is postured proximate the member unit **10** and parallel to it. Although not shown here, this unit may be axially rotated 180 ° and the hoops of the unit interleaved with those of the doublet. This arrangement is known as “staggered array”. It will be seen in the **FIG. 12** description, concerning around-the-corner emplacements.

10 **FIG. 5** presents an end elevation of the **FIG. 4** array. The members **10 / 10D** may be arrayed in either unit, doublet or mixed assemblage; likewise they may be in parallel, staggered or non-staggered registry, so long as a close proximity is maintained, i.e., there are no intervening or intermediate constraints, such as filler materials. **FIG. 6** shows a
15 coil doublet **20D**, in plan view. It, along with its unit of **FIGS. 2 or 3** enjoys almost the same versatility and may be mixed with them, or with the preferred embodiment **10** in standoff arrays.

The aforesaid versatility is clearly seen in **FIG. 7**, where a highly supportive standoff array **30**, comprised of a mix of the preferred embodiment **10** (in parallel arrangement), is cross-linked with the alternate embodiment **20**. The coil usage, in this array, neither uses
20 *nor requires* the strengthening longeron. Other arrangements may be made of either embodiment, with the coil modality free of, or bearing, the longeron **14 (24')**. In a production run, the actual arrangement of the hoop members **10 / 20**, as well as their mix and size, will be selected according to the function to be performed. For example, where

a “pour through” of concrete is desired, spacing of elements to create voids in the array may be provided. A (small) model of such spacing **S** is depicted in the figure. Such a provision would, of course, necessitate removal and sealing of any covering, over and under the array at the selected void areas; such would be done in production or at the site
5 of installation.

From a production standpoint, **FIG. 8** shows the assembly of one aspect of the invention **40** (see, **FIG. 9: 40**) to be straight forward: (1) the desired covering membrane **42** is laid or run out to receive, along desired and discrete portions thereof, a suitable adhesive **A** for fixing support members **10 (20)** to it; (2) the adhesive is disposed on the
10 membrane, in the selected array pattern; (3) the support members are joined to the membrane on the adhesive; (4) additional adhesive **AA** is deposited on the tops of the fixed members; and, (5) another layer of membrane is folded **E(40)** over or otherwise placed onto the ensemble to complete the assembly. Such an assembly process is familiar to manufacturers.

15 Depiction is seen, in **FIG. 9**, of a model of the assembled invention **40**. In this partial cut-away drawing, the supports / stand-offs are a mix of the preferred embodiment, in unit **10** and doublet **10D** modes. The membranous covering **42** is a geo-textile filter fabric, now used throughout the industry; it envelops the array. In some installations, and depending on the sizing of the production models, it may be desirable to concatenate the
20 arrays of the invention **40**. This being the case, a connector **50** is provided to mate a tubular member with its corresponding member in the concatenated array (not shown). The connector consists of a straight tube **52**, a plastic or resin, that is designed to fit snugly into the tubular members’ hoops **12(22)**. To assure that the tubes are not easily

retracted during installation manipulation, a number of detents **54** are provided around the ends of the tube. Too deep an insertion, into the member, is precluded by the presence of a flange **56**, circumscribing the middle of the tube **52**. In most instances of use, an installer requiring concatenation to ensure continuity of fluid passage through the arrays, need only open ends of the invention, thereby creating “flaps”. Concatenation, using only a few of the connectors, can then be finished by sealing the flap ends over the adjoining assemblies. Alternatively, connectors need not be used if the covered, abutting ends of an assembly **40** are taped over with a durable, non-biodegradable adhesive or sealing tape.

10 Remaining drawings, **FIGS. 10 - 12**, illustrate two options featured in the invention **40/40A**, with **FIGS. 10** and **11** directed to covering options, and **FIG. 12**, to a standoff arrangement. It will be noted that **FIG. 10** shows the invention **40**, enveloped in the filter covering **42** over the top and bottom of the quasi-tubular array, which is comprised of unit **10** and doublet **10D** members. For the sake of clarity, no adhesive or alternate stand-off(s) are shown, in any of these three drawings, but it should be reckoned that *any* of the aforementioned features of the invention are, or could be, used.

FIG. 11 discloses another option in the invention **40A**. Here, a partial membranous covering of filter fabric **42** is complemented by a non-biodegradable, water impervious membrane **43**. This option finds utility, particularly, when the invention **40A** is to be placed onto a surface that is to be sealed against water infusion, e.g., outside basement walls. The amount of actual overlap **O/L** depends on a particular usage, manufacturers preferences and the membrane bonding techniques to be used.

FIG. 12 shows an end elevation of the invention featuring yet another optional arrangement of standoff / support members 10 and 10D. The inventor's specifications call for a parallel arrangement of quasi-tubular supports in near or close proximity, that is, eschewing any filler medium between adjacent supports and yet fully contemplating a physical communication between these members (*ibid.* FIG. 7). In FIG. 12, the referenced optional arrangement is termed a parallel, interleaved I/L disposition. The arrangement is simply an alternating, forward-back ("staggered") placement of the supports, of either type (two doublets shown) throughout the array, in pre-selected periodicity. This option facilitates an easier folding or bending of the invention around a corner, thus allowing sharper turns in its placement. Of course, adjustments in either adhesive application (fixture) or membrane looseness may be necessary for such a feature; but they are well within the competence of modern manufacturers.

It should be recognized that the fundamental aspects of this invention can be realized with, for example, quasi-tubular stand-offs of different nomenclature, such as rigid, perforated pipes / tubules / rods--but, *flexibility may be lost to some degree*; a trade-off for the ability to sustain heavier overburdens (see, *e.g.*, FIG. 20 and description).

The clear advantage of using the standoff elemental structures of the invention is seen in the fact that the gap between adjacent hoop planes (FIG. 2: 23), of either embodiment, can exceed the nominal thickness of the discrete hoops. Such advantage is not shared by the multitude of extant drain tubes. Also, reading this disclosure, one may rightly infer that the planar array (FIG 7) may take on any planar geometry, flex to the degree allowed by stand-off size and arrangement, and be covered by both permeable / non-permeable membranes, on either one or both faces of the array. Used not merely to facilitate

around-the-corner installation, as depicted in **FIG. 12**, the interleaved element arrangement, in either embodiment **10/20**, is used by the inventor to augment the support members' strength. This strengthening becomes necessary under very high overburden conditions and, as an option, provides a dual function to the interleaving practice.

5 Having discussed the fundamental aspects of the invention, it becomes incumbent upon this inventor to offer the reader some insight as to the versatility inherent in the use of the invention's tubule/duct members **10/20**, as well as their hybridizing potential with rods, perforate tubes and other drainage adjuncts. The latter portion of this disclosure is therefore directed to the combinational modalities that become apparent once the
10 invention is understood.

Turning now to **FIGS. 13 - 14C**, the basic interlinked mode **60** of members **10** is acquired by encirclement of the longeron **14** (hoop) of one member **10** by the elements **12** of the adjacent member; the end elevation of this modality being shown in **FIGS. 14A** (open) and **14C** (closed). The hoop elements are made in the manner of a book ring
15 binder, in that they are a relatively thick, but bendable polymer. As shown in **FIG. 14B**, the hoop elements **12** are afforded breaks to facilitate opening, for the potential encirclement of a longeron **14** of another member (**FIG. 14A**). Subsequently, the elements are closed and a snap-in detent **15** is inserted into depression **13**, thus securing the encirclement.

20 **FIG. 15** is an illustration depicting an array **40(M)** akin to that of **FIG. 8**, but lacking the coupling membrane--in favor of stringer **14'** coupling. The number, as well as dimensions, of stringers used will depend on manufacturers and users objectives. This embodiment will find high value in installations that require *in situ* preparation of the

drainage system. This matrix can be cut and stacked, after many a fashion, and covered with stone and/or fabric. The various options shown in **FIGS. 16-20** are particularly suitable for such installations.

Referring specifically to **FIGS. 16** and **17**, there are seen, respectively, a modification
5 **10(M)** of the **FIG. 4** "doublet" and an end elevation thereof. In orthogonal extension from off the common longeron **14**, the uniquely distinct, multiple element **12** nonetheless has the same characteristics as a singular geometric shape of the **FIG. 4** article. The multiple elements can be made by casting, molding or by stamping and cementing/fusing C/F the individual shapes or members. **FIGS. 18** and **19** differ from the previous two
10 drawings only in that one of the elemental arrangements is staggered with respect to the other. In both variations of this modification, the elements can be readily extended by concatenating the geometric shapes outward in their same (common) plane. As will be seen in the following drawing, one is not restricted to a simple planar array, nor a single type element.

15 The flexibility in design and assembly of this invention can be better appreciated with reference to **FIG. 20**. Here an end elevation of a poly-formation ("polyform") **10(P)** of the invention reveals a "U" formation of the elements **12'**. Using the invention to its fullest potential, and in keeping with all disclosure made herein, one readily sees that the various elements and members can be had to form many varied formations such as "L",
20 "T", "U", "V", "W", "X" and "Y" patterns and combinations thereof; these patterns effect "oblique-planar" structures and can be formed using cementing or fusing C/F.

Aside from the fact that, in **FIG. 20** one planar array is no longer co-planar the other, but in an angular relationship (oblique plane) therewith, a very great distinction is

presented in the geometric shapes themselves. The preferred embodiment, arrays of coils or tubules, the latter using elements created by employing geometric shaped articles, is by now quite familiar. Although a plan view is not shown, **FIG. 20** and its description suffice to explain, in conjunction with the invention structures now known, namely
5 **FIGS. 8 - 12**, how the familiar three-dimensional matrix plane (ordinary planes or oblique intersecting) is acquired using other structures, with or without the heretofore disclosed elements/members. **FIG. 23**

The reader's attention is called to the members **R/D** of **FIG.20**. As an option, these may be solid discs (the **D**) used with the ring or hoop shapes **12**. Moreover, in a totally
10 different modality, these **R/D** members are polymeric rods (the **R**), to be used in conjunction with the shown **G/T** elements, which consist of tubules **10** (the **G**) or perforated tubing (the **T**). The resultant array is essentially planar, somewhat less flexible, capable of sustaining much greater overburden than the designs of **FIGS. 1 - 19**.

Turning now to **FIGS. 21** and **22**, there is shown, respectively, a circular or arcuate
15 element **12** and a rectilinear. The novelty shown here is the structural reinforcements **13**, which may be indicated when the invention is designed to sustain heavy burdens such as rock/stone or concrete.

FIG. 23 discloses employment of the devices of **FIGS. 21** and **22** using members of the invention **10**, but crafted with two longerons **14** and the interleaving technique. This
20 stacking of elongated members contemplates a larger scale installation in ditches, against subsoil walls and the like. The invention appears here in a more massive form and is usually assembled member-by-member, *in situ*; thus, the elements bear reinforcement structures **13**.

Final to this disclosure, **FIGS. 24** and **25** show in plan view and end elevation, respectively, an embodiment **70** alternate to the preferred, using the plain coil **20**. Two or more such coils are intertwined by a spiral threading of one through the other. The result is a flexible, adjustable planar matrix characteristic of the invention. As with all
5 embodiments herein, this also may be cloaked with the earlier designated membranous covers.

Improvements of this invention and applications thereof, according to the disclosure, are commended to the field consistent with the appended claims.

10

15

20